ATMOSPHERIC THERMODYNAMICS AND HYDROSTATICS
ATMS 305
FALL 2024 – Post-Helene Revision

The subject of atmospheric thermodynamics concerns the physical behavior of air on a local scale and plays an important role in our quantitative understanding of the atmosphere. The principle of energy conservation lies at the core of thermodynamics. We will focus on the transfer of energy in the atmosphere as air responds to changes in temperature, pressure, and volume. The concepts that you discover in this course provide the foundation for your study in almost every other major topic in meteorology. Along the way, you will use differential and integral calculus and principles of physics to solve real-world physical problems related to meteorology. Ask lots of questions and enjoy!

PROFESSOR

Dr. Christopher Godfrey
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Remote office hours: During the regular class meeting time or by appointment.
   You may call my office (it bounces to my cell phone) during regular business hours. You may send me as many email messages as you wish. If my door is open at any other time, please drop in.

CLASS INFORMATION

Meeting times:	MW 11:00 a.m.–12:15 p.m.
Location:	Online via Moodle
Required text:	Petty, G. W., 2008: *A First Course in Atmospheric Thermodynamics*. Sundog Publishing, 338 pp. (ISBN: 978-0-9729033-2-5)
Website:	https://www.atms.unca.edu/cgodfrey/courses/atms305/

» Please visit https://weather.unca.edu for a list of the student learning outcomes for the Department of Atmospheric Sciences.

GETTING QUESTIONS ANSWERED

I will be available to answer questions via Zoom during the regular class meeting time. I will remain there until either 12:15 p.m. or until the last of the initial synchronous attendees leaves the online meeting, whichever comes earlier. Otherwise, email is by far the best way to reach me and you will usually get a speedy reply. You may also schedule an appointment with me. Please don't hesitate to ask questions about class, other coursework, or the stresses of college life whenever the need arises.

IMPORTANT DATES

Wednesday, 30 October 2024	Exam I	11:00 a.m.–12:15 p.m. via Moodle
Monday, 25 November 2024	Exam II	11:00 a.m.–12:15 p.m. via Moodle
Friday, 13 December 2024	Final Exam	11:30 a.m.–2:00 p.m.

COURSE OUTLINE

1. **Thermodynamics of dry air**
   a. Thermodynamic systems and variables
   b. Equation of state
   c. Properties of gases
   d. Thermodynamic work
   e. Cyclic processes
   f. Thermodynamic diagrams

g. Conservation of energy; First Law of Thermodynamics
h. Second Law of Thermodynamics
i. Adiabatic processes
j. Potential temperature
k. Heat engines

2. **Thermodynamics of moist air**
   a. Thermodynamic properties of water
   b. Moisture variables
   c. Equation of state for moist air
   d. Latent heat and phase transformations
   e. The Clausius-Clapeyron equation
   f. Moist adiabatic processes
   g. Moisture and thermodynamic diagrams
   h. The psychrometric formula
   i. Conservative properties of air
   j. Isobaric mixing

3. **Hydrostatics and stability**
   a. The force of gravity
   b. Geopotential
   c. Hydrostatic equilibrium
   d. The hypsometric equation
   e. Lapse rates
   f. Mean sea level pressure reduction
   g. Hydrostatic stability
   h. Buoyancy
   i. Stability of air parcels
   j. Measures of stability
   k. Stability of air layers
   l. Vertical mixing processes

EVALUATION

There will be two preliminary exams and a comprehensive final exam to assess your progress through the semester. The preliminary exams will take place via Moodle during regular class meeting times. As an important extension of the lecture material, weekly problem sets will help you learn, by repetition and practice, the terminology and methods of analysis used in meteorology. You will have one week to complete each assignment.

There will be no opportunities for make-up exams. Exams must be taken on the scheduled date and at the scheduled time. If you miss the class, you miss the grade. The *only* exceptions to this rule are: (1) serious medical condition (illness or injury) of you or an immediate family member; (2) University excused absence; (3) jury duty; (4) military orders; or (5) persistent Internet connectivity problems that you have notified me about in advance. Only in such instances will an exam be dropped or rescheduled depending on your best interests, but *only if I am notified at least 24 hours in advance*. Except under the circumstances described above, **problem sets must be uploaded to Moodle as legible and printable PDF documents by 5:00 p.m.** on the scheduled due date. I will accept problem sets up to 24 hours late for a 50% late penalty. *Assignments more than 24 hours late will not be graded*. In the event of an unforeseen circumstance that causes you to miss an exam or problem set due date, *you must notify me by phone or e-mail within 24 hours of the event*. Appropriate documentation must accompany any excused absence and should be attached to a late assignment.

ACADEMIC INTEGRITY

Since the point of this or any class is to learn, you may discuss problem sets with other students, but *you absolutely must make sure that you hand in your own work and that you understand the material*. Copying your friend's answers will not only be obvious to me, but will result in both of you sharing the credit for that answer. For example, if you do a fantastic job on the assignment and then let three of your friends copy *any part of it*, you will each receive a maximum grade of 25% for the assignment. Any collaboration on exams is simply cheating. I have zero tolerance for academic misconduct and will deal with the problem by immediately filing charges through the regular University channels.

LECTURE AND PROBLEM SET TIMING

All course lecture videos and all problem sets for the remainder of the semester are available on Moodle. Each lecture appears under a header to indicate the date on which you are responsible for learning the corresponding material. The deadlines for the remaining problem sets are November 4, 11, 18, 25, and December 4 for problem sets 5, 6, 7, 8, and 9, respectively. I have provided these course materials for you so that you can work at your own pace, provided you meet the assignment deadlines. You may work ahead, but do not fall behind!

EXAMS, CLASS TIME, AND OFFICE HOURS

Exams will take place via Moodle during the regular class meeting time. Please prepare accordingly and have your equation sheet, calculator, blank paper, and computer ready. You will need to scan your handwritten work and submit it via Moodle after you complete the exam. If you need an exception to the timing of an exam, please notify me in advance.

I recommend that you watch the lecture videos during the regular class time and join a synchronous Zoom meeting to ask questions about the material. This way, you will have your professor available for immediate help and you will benefit from your classmates' questions, but you can review the lecture videos and take notes at your own pace. This synchronous meeting will effectively serve as my office hours, so you are also welcome to ask questions about the problem sets during this time. After each of the exams, we will use this time to conduct a formal exam review, which will be recorded and shared. Please note that attendance at synchronous Zoom meetings is not required, but I strongly recommend attending if you are able.

GRADING

Preliminary Exams	40%
Problem Sets	30%
Final Exam	30%

I reserve the option to curve the final grades upward at my discretion. However, you are guaranteed *at least* the following based on your final score before applying any curve:

A	≥92.0%	C	72.0–77.9%
A-	90.0–91.9%	C-	70.0–71.9%
B+	88.0–89.9%	D+	68.0–69.9%
B	82.0–87.9%	D	60.0–67.9%
B-	80.0–81.9%	F	<60.0
C+	78.0–79.9%		

Final grades are not negotiable. If you see a problem with an exam or homework grade, you may plead your case no later than 14 days from the date I return the assignment to the class. I do make mistakes. Under no circumstances will your grade be *lower* if you see me with a question.

NOTES

University of North Carolina at Asheville is committed to making courses, programs and activities accessible to persons with documented disabilities. Students requesting accommodations and/or academic adjustments must do so through the Office of Academic Accessibility and may be required to provide supporting documentation. All information provided will remain confidential. For more information, please contact the Office of Academic Accessibility at (828) 232-5050 or academicaccess@unca.edu or visit them in the Academic Success Center.